DERAMUS YARD GETS A FACE LIFT

Design/Build for Shreveport-
Deramus Yard Reconstruction

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Introduction

This paper is an overview of design/build improvement of Deramus Yard in Shreveport, Louisiana as a nerve center of the Kansas City Southern RR where hundreds of cars arrive every day, and re-classified into new blocks/trains and departed toward their new destination. It is not our purpose to present the findings of any particular theoretical research, or suggest or advertise any particular supplier in the railroad industry, but to address the key project objectives to change the dynamic set-up envelope of the existing conventional flat classification yard in to an modern automated intermodal facility.

As traffic has continued to grow, Kansas City Southern decided it was time to upgrade its half-century-old Deramus Yard in Shreveport, Louisiana. See Figure #1 The railroad chose the design-build concept, and a few new wrinkles that helped improve the yard's efficiency.

Deramus Yard is at the heart of the KCS system, which serves the central United States and Central Mexico See Figure #2. The yard was built in 1955 on a 257-acre property seven miles northwest of Shreveport, Louisiana and consists of about 75 miles of track with more than 150 turnouts.

The project got rolling in May 2005 when KCS awarded a design-build contract to a design-build team led by Hill Brothers Construction and Engineering Company, Inc. and Wilbur Smith Associates, Inc. to rebuild this major yard. The scope of the project continued to evolve as work progressed.

With this project, KCS sought to achieve improved efficiency, increase throughput and reduce the number of trains held outside the yard. The key component is the modification from a flat yard to a hump yard.

As the project progressed, the estimate of the ultimate project cost evolved to $75 million, making this the nation's largest ongoing yard improvement project.

Key project objectives are:

- Convert existing flat yard to computer-automated hump yard.
- Apply a unique rail design for more efficient yard throughput.
- Improve yard layout to allow processing of 1,700 to 2,000 rail cars per day versus current output of 800 to 1,000 rail cars per day. With the advanced design, the yard should be able to handle up to 3,000 cars per day, a considerable improvement over the original goal. See Figure # 3
- Separate all yard operations from main line track operations.
- Separate receiving/departure tracks from the classification yard.
- Provide additional receiving and departure track with the minimum length of 7,800 feet.
- Provide for inspection/service roads along all receiving and departure tracks.

Engineering responsibilities for the design team included conceptual and final design of new hump yard layout; leading the effort to identify public funding for particular project elements; leading the public relations effort and permit acquisition; negotiating for additional right-of-way needed; roadway and railway bridge design; utility relocation design and permanent and temporary lighting design.

Engineering responsibilities also included geotechnical engineering; designing and reconfiguring site and yard drainage; environmental permitting; aerial mapping and ground surveying; designing a new crest building and track scale; designing new yard air facilities; designing new local yard; levee stabilization and planning a unique yard configuration.

**Planning the Deramus Yard Configuration**

The goal of Deramus Yard design is to perform a specified level of work while maximizing the productivity. See Figure #4 for a Schematic plan of the yard.

I will introduce specific basic principles of Yard design which EMANATE from and are a natural outgrowth of the objective to maximize productivity and minimize operational costs. The design of the Deramus yard which involves compromising and balancing the principles, is as much of an art as a science.

**Principle 1.**
Minimize Conflicts and Interference. The layout should facilitate conflict-free movement of all activities.

**Principle 2.**
Minimize Engine travel. Layout minimizes engine pulling and shoving distances.

**Principle 3.**
Adaptability to various operating conditions. The yard layout is adaptable to operate effectively with respect to changes in traffic levels and patterns deviations from desired operating practices.

**Principle 4.**
Flexible Engine and Crew Utilization. The Yard is configured so that there are short distances of travel and ease of movement between primary areas of work.

**Principle 5.**
Design for Supervision. Deramus Yard is laid out to enhance supervision of engines and crews under direct visual supervision.
**Configuration**

Through “lessons learned” I introduced several crucial improvements to boost Deramus Yard throughput.

**Cycloid Curve**

A key decision was the selection of a Cycloid curve rather than a Circular curve in the vertical plane as the minimum time path between two points in a constant one-g gravitational field. See Figure #5 This is a very rare approach seldom if ever seen by North Americas railroad professionals. There is a direct relation between the velocity the railcar travels and railcar wheel spin. Dynamic examination of the adopted cycloid vertical profile enables a higher speed to be maintained through the switching area, and reduces the likelihood of railcars catching up to one another or being misrouted. Cycloid application allowed designers to reduce absolute crest height maintaining the railcar stall positions (to reach any point in the bowl)

**Hump End of Classification Yard**

The general rule is to lay out the hump end of the classification yard to minimize the distance from the clear point of each classification track to the hump crest because the clear point of the two outside tracks is generally the farthest away it is sufficient to minimize this distance.

**Pull-out End of Classification Yard**

Deramus Yard has a parallel R&D Yard adjacent to the longest classification track and we used a half-fish tail design for pull-out end.

The goal of the Deramus Yard design is to perform a specified level of work while maximizing productivity.

The principal design objectives were to minimize conflicts and interference during construction and to minimize engine travel in the new facility.

**Systematic approach**

We approached the reconstruction of the yard in such a way that we will limit the interference to the KCS with its own ongoing operations. For example, we are constructing the receiving and departure tracks and local yard first so that the KCS has the room to use these tracks while we are working on the classification yard.

The classification tracks will be phased in three group stages. While the receiving and departure tracks are being constructed See Figure #6, the hump and the group leads will be under construction See Figure #7.
Work will be staged so that two inadequate roadway underpasses at either end of the yard can be replaced. At the North end of the yard the road crossing will be shifted several hundred feet to the North and a new highway bridge over the mainline tracks will be constructed (see Figure #13a and b). The South underpass will be reconstructed to accommodate additional tracks (see Figure #14a and b).

Several improvements are designed to boost Deramus Yard throughput.

Instead of master, group and "tangent point" massive retarders, Deramus Yard is equipped with devices called piston retarders, self-contained devices that provide accurate continual velocity control. See Figure #8

Piston retarders consist of a piston-and-cylinder positioned so that a wheel flange depresses the piston as the car passes over. See Figure #9 A valve in the retarder slams shut if the railcar's velocity exceeds a preset value, forcing hydraulic fluid through a narrow orifice creating resistance to the downward pressure of the wheel and slowing the railcar. If the railcar is moving slower than the preset velocity, the piston compresses without resistance.

Velocity control is achieved by the principle of extracting energy from the railcar as it rolls over the retarders. When a retarder setting is given as, for example, four point tree mph-1,180 J, this means that at four point tree mph this retarder extracts 1,180 Joules of energy from a railcar. See Figure #10 As we know, energy cannot be destroyed, but can be transferred from one form to another energy form such as heat, sound or vibration.

To enhance movement control of the railcar, the scale is placed on the incline side of the crest, which allows velocity control based on the weight of the car from the earliest point on the decline vertical plane.

The selection of a cycloid curve in a vertical plane as the minimum time path between two points in a constant one-g gravitational field is a very rare view of science, one seldom, if ever, seen by North America’s railroad professionals. There is a direct relation between the velocity the railcar travels and railcar wheel spin.

Dynamic examination of the adopted cycloid vertical profile enables a higher speed to be maintained through the switching area, and reduces the likelihood of railcars catching up to one another or being misrouted. See Figure #11a & b Cycloid application allowed designers to reduce the absolute crest height, maintaining the railcar stall positions to reach any point in the bowl. See Figure #12
Schedule

Construction started August 2005 with an upgrade and rearrangement of eastern receiving and departure tracks. In 2006, the designers completed the design work for the classification yard design, including bowl and hump and trim leads.

This past month, January 2007, crews started trim leads construction. In 2007, work includes erecting new high-mast yard lighting and adjusting and placing all the new utilities to accommodate the new facility and Phase 1 bowl adjustment.

In 2008, work includes constructing the hump, crest building and track scale; grading and drainage to the south end; constructing a hump east receiving and departure bypass track; installing new active piston-type retarders; implementing new hump control management system. See Figure #15

In 2009, the schedule calls for rehabilitating eight west receiving and departure tracks, spreading track centers to accommodate inspection/service roads; extending two trim ends south along with the east receiving and departure bypass track; completing yard lighting; constructing a new roadway overpass at the north end of the yard; constructing a new railroad overpass at the south end of the yard; rehabilitation of 30 classification tracks and power operating turnouts; and completing the yard air system at the north end of the receiving and departure tracks.

Completion of the classification yard construction is set for 2009 and the west receiving and departure construction is set for 2010.

The advantage of the design-build approach allows progression of initial stages concurrent with development of design details for later stages, as well as permitting and other activities that might otherwise delay project start.
Figure # 1: Deramus Yard Looking South
Figure # 3: Deramus Yard Improved Capacity
Figure # 4: Deramus Yard Schematic Diagram
Figure # 5: Vertical Hump Configuration
Figure # 6: East R/D Tracks Configuration
Figure # 7: New East R/D Track Regulation
Figure # 8: Retarder Placement
Figure # 9: Piston Retarder Section
Figure #10: Energy Extraction vs. Car Speed
**Figure # 11 a)** Load vs. Empty Car Speed Chart

**b)** Car Distance Traveled vs. Time
Figure # 12: Classification Tracks Dynamic Profile
Figure # 13:  

a) Existing Bridge at Martin Luther King Drive - to be closed

b) Proposed Relocation of Martin Luther King Drive
Figure # 14: a) Existing bridge at Lakeshore Drive.

b) Proposed Bridge at Lakeshore Drive
Figure #15: Deramus Yard 2008 Construction